

A method in a process control system and a process control system

The invention relates to a method according to the preamble of claim 1
in a process control system. The invention also relates to a process
5 control system.

In automatic control of industrial processes, real-time data and history
data about the status of the process are displayed to a user at a termi-
nal. For process control systems, there are graphic user interfaces, by
10 means of which information about different parts of the process can be
displayed graphically (with graphs, diagrams, tables, process graphic
diagrams consisting of symbols). These user interfaces can be based
on different operating systems which make it possible to process data
for example in the form of windows on the screen of a display device.
15 The different parts of the process, either as large systems or as more
detailed images, are displayed to the user on the display device of the
terminal as displays which may contain process charts, graphs, tables
and, in general, any information illustrating the parts of the process and
the run of the process.

20 In connection with the terminal, also an input device is provided, to give
commands for controlling the process. The display device of the termi-
nal is normally a display screen in a control room or the like, and the
input device is normally a keyboard with its peripheral devices, includ-
25 ing a device for controlling a cursor or pointer movable on the screen
(e.g. a mouse). The input device can also be the screen of the display
device itself, which is capable of directly receiving control commands,
such as touches. The terminal can also be stationary on the field
(outside the control room, near the process), or a portable or wearable
30 device.

The displays can be arranged hierarchically so that, for example, by
selecting a part of a display on a higher level of hierarchy, a display on
a lower level of hierarchy is displayed. In a larger view on the display
35 device, this part of the display can be displayed as a certain framing or
in another way, and this can be selected by means of the cursor or
pointer. Furthermore, the displays can be linked in such a way that by
selecting a link in a display, a display linked with this display is

accessed. Furthermore, it is possible that displays can be selected from menus which can be retrieved in the display device, or the address of the image can, in principle, be also directly written, if the displays are identified with specific address data, such as file names.

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Graphic user interfaces applying data in the form of various displays to control and monitor an industrial process are presented *e.g.* in US patents 5,918,233 and 5,576,946 as well as in European patent 721611. It is typical of such user interfaces that the operator (person
10 monitoring the process) can control the process by means of the user interface, *i.e.* to enter data by the input device to control the process and to monitor the run of the process, observe disturbance messages or alarms from different locations, *etc.* Furthermore, as is typical for the programs, situation specific instructions related *e.g.* to the relevant
15 process portion or process step can be shown in the user interface.

A problem in the above systems is that for the purpose of process control, a process graphic diagram displayed on the display device of a terminal does not give a good picture of, for example, the physical
20 location of various devices (pumps, valves, measuring devices, *etc.*) in the plant in which the process takes place. The chart displayed on the display device is a process graphic diagram based on the operation of the process and the devices related thereto. If the operating personnel detects, on the display, a disturbance message concerning, for
25 example, a pump, this particular pump cannot be physically located on the basis of the process graphic diagram.

Furthermore, US patents 5,880,716 and 5,982,362 disclose systems in which a video camera is placed in the field. By means of this video
30 camera, a real image is produced of the object, for example simultaneously with the corresponding process graphic diagram. The purpose of the systems is to facilitate the control of the process, and by means of them, it is possible, for example, to monitor in real time how the process is affected by the control measures taken at the terminal. For
35 example, US patent 5,412,400 shows a display device in a process monitoring system where a real image taken by a television camera can be displayed in a separate window on a screen.

In addition, in process control technology, an aim has been to improve the informativity of real images. Therefore, for example German application publication 1954065 discloses a method for providing a stereoscopic effect in an image formed on a projection surface.

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It is true that by the video technology disclosed in the above-mentioned publications it is possible to monitor real objects corresponding to symbols shown in process graphic diagrams, for example their behaviour and the effect of control measures on them, but this will hardly facilitate finding them in the field.

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It is an aim of the invention to eliminate the aforementioned drawbacks and to present a method which is more capable than those of the prior art of giving information about the process both in process graphic diagram format and in the form of images illustrating the process environment itself (the field). To attain this purpose, the method according to the invention is primarily characterized in what will be presented in the characterizing part of the appended claim 1.

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To the portions of the process graphic diagram displayed on the terminal are allotted graphic images indicating the physical location of the respective objects and stored as separate files. The graphic image can be displayed by the control device of the terminal, for example by activating the corresponding portion of the chart. This graphic image can be a three-dimensional image which is preferably of a type whose scale can be changed and which can be turned in different angles of viewing, and preferably it is possible to "wander" in it so that, after enlarging, the image can be turned again, that is, it is possible to "dive" into the image. The graphic image is not a video image but an artificially produced picture, best described as a "virtual image", which corresponds to a real view of the plant and which preferably can be controlled by a graphics program in the user interface. The graphic image can also be a two-dimensional map-like representation, for example a ground plan indicating the location of the object. The graphic image gives a good impression on where, for example, a place corresponding to a given portion in the process chart is located in the field itself, that is, it gives, in a way, the location of the place in a three-dimensional coordinate system. This considerably increases the

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possibilities for using the system for example in disturbance situations, in which one must, for example, get to the target location in the field. By means of the invention, malfunctioning objects can be located faster, and the disturbances can be removed faster. The invention can also be used for training, wherein for example new operating personnel becomes quickly familiarized with the plant, in which the process takes place.

In particular, the invention is suitable for use in connection with such a terminal which is movable, that is, it comprises a movable display device and an input device which can be carried along when moving in the plant. It can be a portable terminal or a so-called wearable terminal, in which latter case the display can be fixed for example at the height of the user's head in such a way that it can be monitored when walking in the plant.

In this context, three-dimensional does not mean an image which should necessarily have a stereoscopic effect, but it is an image which graphically illustrates a three-dimensional space and from which the locations of different elements can be determined. By turning the image into different positions, a particularly informative three-dimensional image is obtained, because it can display, for example, parts concealed behind some elements, and it is thus more informative than a mere single standard, possibly zoomable view which is seen from one direction and which is by some means provided with a stereoscopic effect, or a mere video camera image.

Also other information can be connected with the graphic image, for example written location instructions, "navigation instructions". It is also possible that a 3-dimensional view and a ground plan image can be displayed together, for example in separate windows.

Further, it is possible to arrange an automatic function in connection with the graphic image in such a way that it displays an overall view of the target, for example a whole plant in which the process takes place, and after this, it zooms in on the target to be found, thus displaying it in a larger scale. This function can be arranged both in a 3-dimensional view and in a ground plan.

In the following, the invention will be described in more detail with reference to the appended drawings, in which

5 Fig. 1 shows the operating environment of a control system as a diagram, and

Fig. 2 shows one feasible embodiment of the invention as an image displayed on a display device in the user interface.

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Figure 1 shows the operating environment of a process control system. The process 1 is, in principle, any industrial process comprising several variables which can be measured and which are monitored, controlled and/or adjusted. Thus, the process can comprise, for example, one or more closed control loops. Level 2 "Measurements, adjustments, controls of the control system" describes the measurements by the system and the operations conducted by the system. The arrow from the process describes information obtained from the process, such as measured values and/or status data. The arrow to the process describes measures to control and/or adjust the process. The third level describes the user interface software 3, by means of which the operator can monitor and control the process. The user interface software 3 is in bidirectional communication with the measurements, adjustments and controls of the control system. The user interface software 3 comprises several graphic images 5 which can be viewed with a terminal 4 using the user interface software. Images 5 show several objects which correspond to a specific location that can be defined with 3-dimensional coordinates in a plant in which the process to be controlled takes place. The terminal comprises a display device 4a and an input device 4b. The input device can comprise, for example, a keyboard and a mouse to move a cursor movable on the display and to control the functions produced by it. The input device 4b can also be a display screen operated by pointing with a finger. The terminal 4 can also be carried along in the field.

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To these objects, which are often represented by symbols in the chart, correspond graphic images 6 which are indicated with the note "graphic images" in Fig. 1. These graphic images illustrate a concrete object

(pump, valve, any other actuator, measuring device or a part of the process equipment, such as a tank, a pipe, *etc.*), generally any concrete part which is displayed as a specific symbol or set of symbols in the user interface. This object can be shown in the virtual image in such a manner that it is clearly visible, for example it can be represented in a manner that distinguishes it from the background of the virtual image. Also the whole image may correspond to a certain physical object. The physical objects are shown as virtual images which are not camera views of the objects.

Figure 2 shows, as an example, how it is possible to display on the terminal, for example by selecting a given part of the process graphic diagram with the input device, a three-dimensional graphic image (virtual image) which can be displayed as a separate window or be changed over the original graphic diagram or be changed into a window that is already open but shows another graphic image. The graphic image window comprises control buttons, menus or the like, by which it is possible to control the graphic image itself, for example to enlarge it, to turn it in different angles of viewing, or to wander inside the graphic image.

When one wants to view a portion of an image that is currently displayed on the display device as said three-dimensional graphic image, it can be selected in several different ways. The point of the image may comprise a corresponding button which can be activated to access the graphic image. It is also possible that by moving the cursor or pointer in the image, those points at which a three-dimensional graphic image is accessible, are displayed and indicated in a suitable way. Similarly, by clicking a point in the image, a menu can be displayed, from which the graphic image is selected. Furthermore, it is possible that in connection with a certain event in the process, for example a disturbance, the corresponding three-dimensional graphic image is automatically displayed.

The way of displaying the graphic image itself can also vary. It is possible that in the same process graphic diagram, particularly when illustrating an overall view, different objects are indicated, which can be activated by means of a control device, for example a cursor or pointer,

to display their details in a larger scale. These details can, in turn, be processed as separate graphic images. Such details can be distinguished in the three-dimensional graphic image for example by circling, by changed background, by a symbol, or in a corresponding way. The object which was initially selected in the process graphic diagram can be marked or highlighted in the graphic image in some suitable way to find it more easily.

It is also possible that a general view and a partial view are displayed in parallel in the display device, as separate three-dimensional graphic images which can be separately processed (turned, enlarged *etc.*). The graphic image can also display other information about the object it illustrates, for example in the case of a measuring device, the values given by the measuring device, or in the case of a tank, for example the level of the tank, or in general, all possible status data about the object.

Ground plans can be analogically used in the same way as the 3-dimensional graphic images (virtual images), that is, they can be displayed in corresponding windows.

The invention is not restricted solely to the embodiment described above, but it can be modified within the scope of the inventive idea presented by the claims.

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